REMARKS

Claim 1 has been amended based on the disclosure at page 18, lines 2-3 in the application as filed. Claims 14-32 have been canceled.

Entry of the above amendment is respectfully requested.

Rejection under 37 C.F.R. 112, Second Paragraph

On page 2 of the Office Action, in paragraph 3, claim 32 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite.

In response, Applicants have canceled claim 32. Accordingly, Applicants submit that this rejection is obviated, and withdrawal of this rejection is respectfully requested.

Art Rejections

On page 3 of the Office Action, in paragraph 8, claims 1-6, 8-9, 12-19, 21-22, 25-29 and 32 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over DAIDO et al. (US 2003/0003363 Al). Further, on page 5 of the Office Action, in paragraph 9, claims 7 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over DAIDO et al. (US 2003/0003363 Al) as applied to claims 1-6, 8-9, 12-19, 21-22, 25-29 and 32 above, and further in view of NAKAMIZO et al. (US 2001/0004504 Al). In addition, on page 5 of the Office Action, in paragraph 10, claims 10-11, 23-24 and 30-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over DAIDO et al. (US 2003/0003363 Al) as applied to claims 1-6, 8-9, 12-19, 21-22, 25-29 and 32 above, and further in view of WATANABE et al. (US 6,083,644).

Applicants respectfully submit that the invention as recited in the amended claims is neither anticipated by nor obvious over the cited art, and request that the Examiner reconsider and withdraw these rejections in view of the following remarks.

a. The present invention and the invention of Daido (US 2003/0003363A1) have both an object to provide a battery developing an overcharge-preventing function. The term "overcharge-preventing function" refers to a function such that doping cannot occur at the negative electrode during overcharge, so that the deposited lithium particles reach the vicinity of the positive electrode surface, doping the positive electrode, and thus preventing further overcharge of the battery.

b. The mechanism of the overcharge-preventing function will be explained below with reference to Fig. 1 enclosed herewith.

As shown in Fig. 1 (A), where the charging rate is 0%, all of the lithium to be utilized for charge-discharge exists in the positive electrode, and the negative electrode is in the state of containing no lithium. When charging is started, the lithium in the positive electrode starts to move to the negative electrode while passing through the separator so that the lithium is caused to be doped into the negative electrode.

As shown in Fig. 1 (B), where the charging rate is 100%, the negative electrode is thoroughly doped with lithium while a prescribed amount of lithium is retained in the positive electrode. Of course, the lithium volumes of the positive and negative electrodes should be balanced so that the prescribed amount of lithium is retained in the positive electrode.

When the battery is further charged, for example, to a charging rate of 110%, as shown in Fig. 1 (C), the lithium retained in the positive electrode moves to the negative electrode side and

starts to form a deposit onto the negative electrode surface. And, at this time, the increase of the battery voltage almost stops.

If charging is continued further, the lithium deposit grows to extend towards the positive electrode surface side and forms a deposit such as shown on the left side of Fig. 1 (D). A deposit of greater growth such as shown on the right side of Fig. 1 (D) becomes to slightly contact with the positive electrode surface at the top portion thereof, and the lithium in the top portion is caused to be reabsorbed by the positive electrode through redox reaction. At this time, the battery voltage is slightly decreased.

If charging is furthermore continued, since the growth of the lithium deposit and the reabsorption of the deposited lithium by the positive electrode are repeatedly continued, the battery voltage oscillation of up and down is repeated within a prescribed range, even where the charging rate becomes 500%, for example, as shown in Fig. 1 (E).

The function that the growth of the lithium deposit and the reabsorption of the deposited lithium by the positive electrode are thus repeatedly continued, even in the overcharging range, to prevent complete internal short-circuit between the positive and negative electrodes is referred to as the overcharge-preventing function.

c. The overcharge-preventing function as explained above becomes possible to be developed depending on the balance of the amounts of the positive electrode active material and negative electrode active material used and the control of the morphology such as the Gurley value of the separator (see page 17, line 25 through page 18, line 10 in the present application). Thus, it does not depend merely on the balance of the amounts of the positive electrode active and negative electrode active materials used or merely on the morphology of the separator.

d. The battery according to the present invention as amended above to recite relationship II is clearly different from the battery described in Daido.

Daido focuses the relationship among the amount Qp of lithium contained in the positive electrode, the amount Qn of lithium capable of being doped in the negative electrode and the electric charge Qc for charging. Contrary to this, in the present invention, the relationship is focused, as shown in the enclosed Fig. 2, among the total amount Qp of lithium contained in the positive electrode active material, the amount Qpr of lithium utilized for charge-discharge reaction of the lithium contained in the positive electrode active material, the amount Qn of lithium capable of being doped in the negative electrode active material, the value qm for the overcharge-preventing function of the separator, the weight Wp of the positive electrode active material and the weight Wn of the negative electrode active material. Daido discloses, as described in claim 1, that the overcharge-preventing function is developed where the relationship of $1 < Qc/Qn < Qp/Qn$ is satisfied. This relationship in Daido can be converted into the following formula III in accordance with the relationships as adopted in the present invention:

$$1 < Qc/Qn < Qp/Qn \rightarrow Qn < Qc < Qp \rightarrow QnWn < qm + QnWn < QpWp \quad \text{III},$$

while it has been found in the present invention that the overcharge-preventing function is developed where both of the relationships I and II are satisfied. This relation between Daido and the present invention is summarized as shown in the enclosed Fig. 3, which clearly shows that the ranges "qm + QnWn" are not the same between Daido and the present invention.

That is to say, it is considered in Daido that the overcharge-preventing function is not developed in the case of $qm + QnWn > QpWp$ ($Qc > Qp$), while it has been found in the present invention that even in this case, if the relationship II of $QpWp < qm + QnWn < 1.3QpWp$ is satisfied, the overcharge-preventing function effect to a certain extent can be attained, and there

is no problem in ensuring safety (see page 17, line 25 through page 18, line 10 in the present application).

Further, as shown in Table 4 of the present application, the cells with very good results of ◎ in Evaluation 2 such as cell Nos. 3, 4, 7, 8, etc. are those falling within the range of the conditions of Daido and the cells with good results of O in Evaluation 2 such as cell Nos. 2, 6, 10, 11, etc. are those falling within the range of the conditions of the present invention as amended above. From this fact, the difference between the invention of Daido and the present invention can also be understood.

Therefore, Applicants submit that it is clear that the present invention is not disclosed in Daido.

e. Nakamizo (US 2001/0004504A1) discloses a positive electrode active material combined with $LiMn_2O_4$ and $LiNiO_2$ at page 5, paragraph [0070]. However, Nakamizo neither teaches nor suggests a battery having the overcharge-preventing function according to the present invention as mentioned above. Therefore, Applicants submit that the present invention is clearly distinguished from the combination of Daido with Nakamizo.

f. Watanabe (US 6,083,644) discloses a battery separator consisting of non-woven fabric, porous material or cloth comprising glass fibers at column 13, lines 50-55. However, Watanabe neither teaches nor suggests a battery having the overcharge-preventing function according to the present invention as mentioned above. Therefore, Applicants submit that the present invention is clearly distinguished from the combination of Daido with Watanabe.

Accordingly, Applicants submit that the invention as recited in the amended claims is neither anticipated by nor obvious over the cited art, and withdrawal of these rejections is respectfully requested.

Obviousness-Type Double Patenting Rejection

On page 6 of the Office Action, in paragraph 12, claims 1-2, 8-9, 12-15, 21-22, 25-29 and 32 rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1, 8, and 10-12 of U.S. Patent No. 6,818,352 B2.

In response, Applicants submit that the invention as recited in the amended claims is not obvious over claims 1, 8, and 10-12 of U.S. Patent No. 6,818,352 B2 to Daido for the reasons given above with respect to Daido (US 2003/0003363A1), since US 2003/0003363A1 is the publication of the application which issued as US 6,818,352 B2.

In particular, Applicants submit that the battery according to the present invention as amended above to recite relationship II is clearly different from the battery described in Daido.

Daido focuses the relationship among the amount Qp of lithium contained in the positive electrode, the amount Qn of lithium capable of being doped in the negative electrode and the electric charge Qc for charging. Contrary to this, in the present invention, the relationship is focused, as shown in the enclosed Fig. 2, among the total amount Qp of lithium contained in the positive electrode active material, the amount Qpr of lithium utilized for charge-discharge reaction of the lithium contained in the positive electrode active material, the amount Qn of lithium capable of being doped in the negative electrode active material, the value qm for the overcharge-preventing function of the separator, the weight Wp of the positive electrode active material and the weight Wn of the negative electrode active material. Daido discloses, as described in claim 1, that the overcharge-preventing function is developed where the relationship of $1 < Qc/Qn < Qp/Qn$ is satisfied. This relationship in Daido can be converted into the following formula III in accordance with the relationships as adopted in the present invention:

$$1 < Qc/Qn < Qp/Qn \rightarrow Qn < Qc < Qp \rightarrow QnWn < qm + QnWn < QpWp \quad \text{III},$$

while it has been found in the present invention that the overcharge-preventing function is developed where both of the relationships I and II are satisfied. This relation between Daido and the present invention is summarized as shown in the enclosed Fig. 3, which clearly shows that the ranges "qm + QnWn" are not the same between Daido and the present invention.

That is to say, it is considered in Daido that the overcharge-preventing function is not developed in the case of qm + QnWn >QpWp (Qc > Qp), while it has been found in the present invention that even in this case, if the relationship II of QpWp < qm + QnWn < 1.3QpWp is satisfied, the overcharge-preventing function effect to a certain extent can be attained, and there is no problem in ensuring safety (see page 17, line 25 through page 18, line 10 in the present application).

Further, as shown in Table 4 of the present application, the cells with very good results of ◎ in Evaluation 2 such as cell Nos. 3, 4, 7, 8, etc. are those falling within the range of the conditions of Daido and the cells with good results of O in Evaluation 2 such as cell Nos. 2, 6, 10, 11, etc. are those falling within the range of the conditions of the present invention as amended above. From this fact, the difference between the invention of Daido and the present invention can also be understood.

Therefore, Applicants submit that it is clear that the present invention is not obvious over the Daido claims, and withdrawal of this rejection is respectfully requested.

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the

Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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23373
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Date: March 11, 2009